MSG From: ARCNET --ALMVMA To: IT32730 --VIMVMOA 02/02/95 14:41:07á
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Subject: Why Explore Mars?
From: baalke@kelvin.jpl.nasa.gov (Ron Baalke)
Date: 31 Jan 1995 18:20:38 -0800
Organization: Jet Propulsion Laboratory
Sender: daemon@news.arc.nasa.gov
Distribution: world
Message-ID: <1FEB199502244537@kelvin.jpl.nasa.gov>
NNTP-Posting-Host: news.arc.nasa.gov
News-Software: VAX/VMS VNEWS 1.41

From "The Martian Chronicle"
January 1995
(The Martian Chronicle is also available on the World Wide Web at
http://www.jpl.nasa.gov/mars.)

WHY SHOULD WE EXPLORE MARS?
Dr. Matthew Golombek, Mars Pathfinder Project Scientist

Mars is the most Earth-like of the five terrestrial planets and will be the first other planet humans will visit. Why? The Moon and Mercury are dry airless bodies. Venus has suffered a runaway greenhouse effect, developing a very dense carbon dioxide atmosphere that has resulted in the escape of all its water and uninhabitable surface temperatures of 750K. Mars, on the other hand, has everything necessary to support life, including an atmosphere with polar caps and large amounts of water. Mars is, in fact, the only other terrestrial planet with abundant water (and liquid water is absolutely required for life as we know
it). So eventually humans will visit Mars not only because it is the only other planet with reasonable surface conditions, but for the potential of what it might become in the much more distant future¬another home for people.

Mars is also the only other place were we can begin to address the question - "Are we alone in the universe?" Is life a cosmic accident or does life develop anywhere the proper environmental conditions are met? A number of studies have shown that the likelihood of humans hearing from possible advanced civilizations
in other solar systems is extremely remote given the enormous distances (and long time delays) involved. Mars is our neighbor and, unlike any other planet in
our solar system, substantial evidence indicates that early environmental conditions may have been similar to those on the young Earth. On Earth, evidence
for life can be found in some of the oldest rocks, dating from the end of terminal bombardment around 4 billion years ago. Surfaces on Mars that are of this age show remains of ancient lakes, implying that liquid water was in equilibrium with the atmosphere at that time and that the climate was both wetter and substantially warmer. If this is true, then we can learn, through further exploration, whether life did develop on Mars, or if not why not. If life did develop on Mars what has happened to it, given that Viking found no evidence present-day life at the two landing sites? We could even begin to explore whether life that began early on could still survive in some specialized

niches, such as hydrothermal systems near volcanoes.

Finally, exploring Mars provides a way of better understanding significant issues that face humankind in the future, namely the factors involved in natural
changes in a planet's climate. On the Earth, one of the most important questions
now being studied is whether or not humans are contributing to global warming (if it is occurring via industrial emissions). We do not know if we are, or if these changes could produce negative environmental changes such as sea level rise due to melting of the ice cap (most of the world's largest cities are at elevations very close to sea level). Mars, on the other hand, provides a natural
laboratory for studying climatic changes on a variety of time scales. If Mars was warmer and wetter with a thicker atmosphere in the past, why did it change?

In addition, layered deposits near the martian polar caps suggest climatic fluctuations on a shorter time scale. If we can learn the important factors controlling climatic changes on another planet, we may be better capable of understanding the consequences of human-influenced changes on Earth. Lastly, Mars is an excellent laboratory to engage in such a study, given that its geologic activity has produced rocks on the surface of virtually all ages to study. Unlike the overactive Earth and Venus, where most of the surface is covered by young rocks, and the inactive Mercury and Moon, where only ancient rocks are present, Mars has had an intermediate level of geological activity, which has produced rocks on the surface that preserve the entire history of the solar system. Sedimentary rocks preserved on the surface contain a record of the
environmental conditions in which they formed and thus any climatic changes that
have occurred through time.

ÿ žNO SUBJECT
MSG From: ARCNET --ALMVMA   To: IT32730 --VIMVMOA   02/02/95 14:41:14á
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----- SPACENEW USENET appended at 13:35:25 on 95/02/02 GMT (by USENET at ALMADEN)
Subject: Welcome to Mars!
From: baalke@kelvin.jpl.nasa.gov (Ron Baalke)
Date: 31 Jan 1995 18:22:50 -0800
Organization: Jet Propulsion Laboratory
Sender: daemon@news.arc.nasa.gov
Distribution: world
Message-ID: <1FEB199502270309@kelvin.jpl.nasa.gov>
NNTP-Posting-Host: news.arc.nasa.gov
News-Software: VAX/VMS VNEWS 1.41

From "The Martian Chronicle"
January 1995
(The Martian Chronicle is also available on the World Wide Web at
 http://www.jpl.nasa.gov/mars.)

WELCOME TO MARS!
Donna Shirley, Mars Exploration Program Manager

NASA's Jet Propulsion Laboratory is going back to Mars for the first time since 1976 with a small "fleet" of missions: orbiters, landers, rovers, and maybe balloons and sample returns. And we are going in partnership with other countries like Russia, France, Germany, Italy, and Japan. Our plan is to fly at least two robotic missions to Mars every opportunity (that is about every two years) from 1996 through 2005.

Robot spacecraft from the United States and Russia have been flying to Mars since 1964. The last time we visited Mars with a fully successful mission was with the Viking, which flew two orbiters and two landers in 1975 and 1976. The orbiters took pictures of the surface that were sharp enough in some areas to see objects the size of a football field. The landers took close-up images of two spots on the surface and did experiments to search for life. While Viking did not find any life, the possibility that life once existed on Mars is still there. But we now know that finding evidence of life that exists now or in the past is harder than we thought. Missions to Mars have been attempted since Viking, but none have made all the scientific observations that were planned.

On top of that, all the Mars missions that have so far flown have not found out exactly what Mars is made out of. Do the rocks have carbon in them? Oxygen? How much iron and aluminum? Another key question is: Where did all the water go? Mars used to have a lot of surface water. We know that because the orbiter pictures show river valleys and channels. But it all disappeared a few billion years ago, except for a little bit frozen into the polar ice caps. If people are
ever to live on Mars, we will need to find out if we can get water and other materials from the Martian soil, air, or underground.

And we will have to answer these kinds of questions with a program that costs much, much less than the previous Mars missions. For instance, Viking cost, if we were buying it today, almost $4 billion. The first two of our new missions, an orbiter and a lander, will cost less than 10% of that. And every two missions
after that (which will fly to Mars every two years) will cost less than 5% of the cost of Viking.

The Martian Chronicle will keep you posted on the work of the Mars Exploration Program. We will tell you about our missions, what we hope to find, and what we do find when we get there. And we will tell you what is going to be happening and ways for you to get involved as we build and fly our spacecraft. Other articles in the Chronicle will tell you about our plans for educational outreach
and public involvement.

Please e-mail me at donna.shirley@jpl.nasa.gov with your ideas on how we can involve you and other people in exploring Mars.

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MSG From: ARCNET --ALMVMA To: IT32730 --VIMVMOA 02/02/95 14:41:15á
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----- SPACENEW USENET appended at 13:35:31 on 95/02/02 GMT (by USENET at ALMADEN)
Subject: The Mars Surveyor Program

From: baalke@kelvin.jpl.nasa.gov (Ron Baalke)
Date: 31 Jan 1995 18:25:07 -0800
Organization: Jet Propulsion Laboratory
Sender: daemon@news.arc.nasa.gov
Distribution: world
Message-ID: <1FEB199502292460@kelvin.jpl.nasa.gov>
NNTP-Posting-Host: news.arc.nasa.gov
News-Software: VAX/VMS VNEWS 1.41

From "The Martian Chronicle"
January 1995
(The Martian Chronicle is also available on the World Wide Web at
http://www.jpl.nasa.gov/mars.)

THE MARS SURVEYOR PROGRAM

Mars Surveyor is an ambitious but tightly cost-constrained program to explore Mars over the decade from 1997 through 2006. Small orbiters and landers built by
industry will be launched at each of the opportunities, 26 months apart. These multiple launches of small spacecraft provide high science return in a program that does not rely solely on the success of any one component or mission. The total annual costs for the program are capped at less than $150M.

The Surveyor Program will address the many unknowns regarding Mars, our nearest and most Earth-like planetary neighbor. With a total surface area equal in size to all the land areas of the Earth, it is geologically diverse and shows a long and fascinating geologic and atmospheric history. The Mariner and Viking spacecraft of the 1960s and 1970s discovered vast extinct volcanoes, a great canyon 5 km deep that could stretch nearly across North America, layered polar strata that testify to incredible climatic fluctuations. They also discovered that the permanent northern polar cap is water ice, and a multitude of ancient valleys were carved out during a time when liquid water may have flowed across the Martian landscape. In 1976, the two Viking landers searched for life and found none; with no protective ozone layer, ultraviolet radiation relentlessly sterilizes the surface of Mars. Major questions arise immediately: How did Mars come to its present frigid, sterile, and tenuous atmospheric state? Could life have begun long ago on a warmer, wetter Mars, and can a fossil record be found? What is there about Mars' history that may be relevant to our own planet?

The first charge to the Mars Surveyor Program is recovery of the science lost along with Mars Observer (MO). The first Surveyor mission, designated the Mars Global Surveyor (MGS) [see related articles on MGS and the loss of MO elsewhere in this issue], is scheduled for launch in November 1996 aboard a Delta launch vehicle. This is a Mars orbiting spacecraft that will carry a duplicate of the MO camera, laser altimeter (to accurately measure the surface contours of the planet), thermal emission spectrometer, and magnetometer along with communications equipment to relay data to Earth from later surface missions. Two
launches in 1998 will carry an orbiter half the size of MGS with the remainder of the MO payload, and a lander 60% the size of the Mars Pathfinder lander, both
on "Med-Lite" launch vehicles, which will cut the Delta launch costs in half. It

is estimated that 70% of MO science will be acquired at 25% of the original cost.

Additional orbiters and landers are planned for launch at the 2001, 2003 and 2005 opportunities to continue and expand the earlier investigations. Mars will become the first planet outside the Earth to move from the reconnaissance stage to true exploration. Evidence will be gathered on its history, its evolution and
the presently ongoing processes of its atmosphere, surface and interior. Mars Surveyor will also serve as the cornerstone for the projected collaborative international Mars exploration program involving Russian, French, German, Japanese, and European space agencies.

Mars Surveyor also affords an opportunity for significant technology development
and transfer. The cost-constrained nature of the program mandates the development and infusion of technologies that provide either significant reductions in the size and weight of spacecraft or increased autonomy of spacecraft in carrying out their exploration and science missions. Small spacecraft can be launched by smaller, cheaper launch vehicles. Highly autonomous spacecraft reduce operations costs by requiring a much smaller number
of flight controllers than required to monitor and command current spacecraft. In the course of the Mars Surveyor Program, technologies that have potentially dual-use applications will be identified, and mechanisms will be established to insure the efficient transfer of these technologies to industry.

Because of the inherent interest and excitement of children in planetary exploration, particularly the allure of Mars, the Surveyor Program provides an excellent vehicle for conducting a science, mathematics, and space education program directed to grammar, middle and high school students. Products for such a program will be created in collaboration between professional educators and the Surveyor Program staff. Mars Surveyor will also provide a flow of new data that can be excitingly related to global views of the functioning of our own planet.

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----- SPACENEW USENET appended at 13:44:39 on 95/02/02 GMT (by USENET at ALMADEN)
Subject: Whatever Happened to Mars Observer?
From: baalke@kelvin.jpl.nasa.gov (Ron Baalke)
Date: 31 Jan 1995 18:33:03 -0800
Organization: Jet Propulsion Laboratory
Sender: daemon@news.arc.nasa.gov
Distribution: world
Message-ID: <1FEB199502371956@kelvin.jpl.nasa.gov>
NNTP-Posting-Host: news.arc.nasa.gov
News-Software: VAX/VMS VNEWS 1.41

From "The Martian Chronicle"
January 1995
(The Martian Chronicle is also available on the World Wide Web at

http://www.jpl.nasa.gov/mars.)

WHATEVER HAPPENED TO MARS OBSERVER?
Glenn E. Cunningham, Mars Global Surveyor Project Manager

Those of you who had been following the progress of the Mars Observer mission through the pages of the Mars Observer newsletter may have wondered why our communication with you abruptly ceased. The reason is, of course that we lost contact with the Mars Observer spacecraft. At that point, project activities shifted quickly to trying to reestablish communications and to recover the mission, and we abandoned our previously planned issuance of the Mars Observer.

On the evening of August 21, 1993, the flight team was preparing to pressurize the spacecraft's propellant tanks. During the early parts of the mission, the propellant necessary for the three flight path correction maneuvers was forced out of the tanks by the pressure established in them before launch. However, for
the very large rocket engine firing that would be required in three days to alter the spacecraft's trajectory so that it would be captured into orbit around
Mars, the propellant tanks needed to be connected to the on board helium pressurant tank. A large flow of pressurant would be required to force the needed propellant to the rocket engines. After ten months of flight, this was the first time this pressurization activity was done on the Mars Observer spacecraft.

The valves that open to allow the helium pressurant to flow through small-diameter steel tubing to the pressure regulator and on to the propellant tanks are actuated by little explosive charges that are set off with an electrical signal from the spacecraft's central computer. When the valves actuate, a small mechanical shock wave is set off that travels through the spacecraft's structure and is felt by all the electronic components. Some components within the spacecraft are sensitive to be jostled by these shock waves. One such component is the amplifier tubes in the spacecraft's radio transmitter. The effect is much like causing a hot electric light bulb to burn out by sharply jostling it while it is on and hot. So, we turned off the radio transmitter to keep it cool so as not to damage it. This is an event that had been done many times previously during the flight of Mars Observer.

The whole sequence of events that comprised this pressurization of the tanks, including turning the transmitter off and then back on, was controlled by the spacecraft's central computer.

We watched the initial events occur on schedule and the transmitter turn off.....but we never heard the spacecraft's signal again.

Within a few minutes of realizing that the spacecraft's signal had not returned properly, the Deep Space Network trained its largest antenna at the expected position of the spacecraft and the flight team began to exercise the numerous contingency plans that had been established to deal with such emergencies. Heroic activities focused on recovering the spacecraft continued for two months with no positive result, at which time the flight operations team was disbanded.

Within hours, the national media converged on the Jet Propulsion Laboratory for an explanation of what had gone wrong with this mission, which had been progressing so well, and which was on the verge of its most important engineering event, that of going into orbit around Mars.

Try as we could, there was no clear immediate explanation of what had happened. The flight team assumed that some electronic failure had occurred that had prevented the transmitter from being turned back on. All sorts of redundant circuits and components were commanded on-line to no avail. While the situation appeared catastrophic, the flight team vigorously pursued every available path to find a solution. The spirit of the flight team was remarkable in view of the fact that every day with out a signal was more and more a message to us that the
mission had been lost. With our assumption that the transmitter was just off, and our knowledge that the Mars orbit insertion events were all programmed into the spacecraft's central computer, we expected that the spacecraft would go into
orbit around Mars as we had planned, without our help, and even if we could not watch it happen. The ceremonial events of Mars Insertion Day, August 24, 1993, occurred on schedule as we watched and waited without communication with the spacecraft.

Within several days, three special groups were set up to try, independent of the
Mars Observer Project, to determine the fate of the spacecraft. NASA Headquarters appointed a special team, as did JPL, and the spacecraft builder, Martin Marietta Astro Space. After months of review of the spacecraft design documents, review of the spacecraft telemetry to the point of loss of the signal, and special tests of certain spare hardware components, these groups reached essentially the same conclusions.

It was generally agreed that an unintentional mixing of the propulsion fuel and oxidizer in the pressurization system tubing caused a rupture of the tubing, thus spewing the helium pressurant gas, as well as the liquid fuel and oxidizer,
out of the spacecraft. This would have caused the spacecraft to spin at a rapid rate and was the most probable cause of the failure. Contamination by the very corrosive propellants probably caused shorts in the electrical wiring, and the spinning may have caused the main antenna to be torn off. Eventually, because the solar arrays would no longer be pointed at the sun, the spacecraft's batteries would be depleted and unable to power the transmitter. It was postulated that the presence of the fuel and oxidizer in the pressurant lines could have been the result of excessive vapor passing backwards through check valves and a cooler than desirable environment upstream in the tubing. This caused condensation and accumulation of liquid propellant where it should not have been. Opening of the pressurant valves then forced the liquid fuel and oxidizer together.

With this possible explanation of the failure, the Mars orbit insertion events most certainly did not execute, and the spacecraft, or what was left of it, simply flew past Mars on the flight path it was already on and is continuing in its orbit around the sun.

Several other attempts were made to try to ascertain the fate of Mars Observer.

A study was done to see if the Hubble Spacecraft Telescope could see the spacecraft. It turned out, however, that not only was Mars Observer too close to
the sun as viewed from Hubble, but it would be of too little brightness to be seen by Hubble. In addition, there is a small beacon transmitter on the Mars Balloon Relay system on the spacecraft that was to have been used in conjunction
with relaying data from Russian spacecraft at Mars to Earth. Five large radio astronomy antennas in the US, Canada, and England, including the Arecibo antenna
in Puerto Rico, were used over a period of six months to try to hear the small 1-watt signal from this beacon. If it could be heard, it would attest to the fact that the spacecraft was intact, had electrical power, and could receive commands. But, alas, the beacon was also not heard.

So after an agonizing period of time, with the hopes of scientific investigators
dashed, and the emotions of the flight controllers drained, we have concluded that the Mars Observer mission has been lost

But, all is not lost, indeed, for during the period when the flight team was trying to recover the spacecraft, and while the investigation groups were trying
to determine what went wrong, other scientists, engineers and managers were planning how the scientific mission of Mars Observer could be duplicated. So important are these science measurements to improving our knowledge of Mars and in making comparisons to the evolution of the Earth, that NASA and the US Congress have authorized the next mission to Mars, Mars Global Surveyor , to recover as much as possible of the science that would have been done by the lost
Mars Observer. So, although the loss of Mars Observer, the first loss of a planetary mission in 27 years, was a severe blow, the study of Mars will continue.

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----- SPACENEW USENET appended at 13:45:06 on 95/02/02 GMT (by USENET at ALMADEN)
Subject: Mars Global Surveyor
From: baalke@kelvin.jpl.nasa.gov (Ron Baalke)
Date: 31 Jan 1995 18:35:58 -0800
Organization: Jet Propulsion Laboratory
Sender: daemon@news.arc.nasa.gov
Distribution: world
Message-ID: <1FEB199502401995@kelvin.jpl.nasa.gov>
NNTP-Posting-Host: news.arc.nasa.gov
News-Software: VAX/VMS VNEWS 1.41

From "The Martian Chronicle"
January 1995
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MARS GLOBAL SURVEYOR

The goal of the Mars Global Surveyor (MGS) mission is to recover as much as possible of the science that was lost with the loss of the Mars Observer (MO) spacecraft. The project pace is full steam ahead, as we work to complete the spacecraft design, integration, and test to meet the next launch opportunity to Mars in the late fall of 1996.

The basic spacecraft design for MGS is based on that of Mars Observer, but with several reliability enhancements. Since the design of MO has probably been scrutinized more than any other robotic spacecraft ever built, we feel confident that we can develop a very dependable spacecraft in a very short period of time by using the MO design as a starting point and then addressing all of the concerns raised during the MO anomaly investigations. The biggest changes are in the propulsion system design and operation, since this was suggested as the most likely causes of the loss of MO. All of the scientific instruments and most of the avionics for MGS will be derived from Mars Observer hardware, with some minor modifications being made to the avionics and software to address other concerns that were identified by the anomaly review boards.

Aside from the reliability enhancement, all of the major changes to the mission have come as a result of launching the MGS spacecraft on a Delta rocket instead of a Titan, which was used for Mars Observer. Overall, this change requires that the mass launched to Mars be reduced by almost 60%. The biggest part of this savings will come from using a technique called aerobraking to lower the spacecraft into the final mapping orbit. On MO, we planned to slow the spacecraft down into the mapping orbit using propulsive rocket burns, but on MGS we will use the atmosphere of Mars instead. This will take place for a short period of time during each orbit over a 3-month period starting just after the spacecraft arrives at Mars. The actual forces and heating from the atmosphere on any given orbit are not very large, but over the course of many orbits they have a tremendous effect. The aerobraking technique was demonstrated by the Magellan spacecraft at Venus and will reduce the propellant required to fly the MGS mission to 400 kg from the 1400 kg of fuel that would have been required for MO.
We are benefiting greatly from the Magellan experience since most of the key personnel responsible for Magellan aerobraking at Martin Marietta in Denver have now joined the MGS team to help us with the design of the MGS spacecraft for aerobraking. We think we have a good grasp of what is required of the spacecraft for aerobraking, but since MGS will be starting our aerobraking from an orbit that is much larger than the initial Magellan orbit, we are exploring some new territory, mainly in the demands that this will place on the flight control operators after launch, during the actual aerobraking activity itself.

In addition to all of the fuel savings, the spacecraft and payload have also

been put on a diet and now weigh about 60% of what MO weighed (about 650 kg for MGS compared to 1100 kg for MO). Unfortunately, a large part of this mass savings was accomplished by leaving the two heaviest science instruments behind,
but the other six instruments from the MO payload will fly on MGS. Re-using almost all of the avionics from MO is saving a lot of time and money, but unfortunately these components tend to be heavier than what we could make or buy
if we were starting with a clean sheet of paper. To offset this, the engineers responsible for the mechanical design of MGS have found ways to save a lot of mass using lightweight composite materials for the structure and by designing a propulsion system that requires fewer tanks and less plumbing. We successfully completed all of our Preliminary Design Reviews in November, and we are on track
to meet our mass allocation for the Delta rocket, but we will have to keep close
tabs on the mass in order to meet our commitments.

The real challenges on MGS are coming up with a bulletproof design and launching
it on time and on budget. The cost and the schedule constraints are forcing us to take a hard look at the way we normally build spacecraft and to ask "What is the most efficient way to spend the resources that we have?" The lessons we are learning re-integrating the MO heritage hardware and software are teaching us a lot about how to design with "off-the-shelf" hardware (rather than designing from scratch), and the programmatic constraints are forcing us to consider the overall life-cycle consequences of every decision (rather than optimizing the spacecraft at the expense of operations). It is a very exciting work environment, and many of the lessons learned will help us be ready for the kind of projects that are in the Jet Propulsion Laboratory's future.

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----- SPACENEW USENET appended at 13:45:32 on 95/02/02 GMT (by USENET at ALMADEN)
Subject: Mars Pathfinder
From: baalke@kelvin.jpl.nasa.gov (Ron Baalke)
Date: 31 Jan 1995 18:38:05 -0800
Organization: Jet Propulsion Laboratory
Sender: daemon@news.arc.nasa.gov
Distribution: world
Message-ID: <1FEB199502423144@kelvin.jpl.nasa.gov>
NNTP-Posting-Host: news.arc.nasa.gov
News-Software: VAX/VMS VNEWS 1.41

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January 1995
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 http://www.jpl.nasa.gov/mars.)

MARS PATHFINDER
Tony Spear, Mars Pathfinder Project Manager

Mars Pathfinder, launching in December 1996 and landing July 4, 1997, will demonstrate a low-cost delivery system to the surface of Mars for follow-on Mars Surveyor and Discovery Program landers. Historically, spacecraft that orbit or land on a distant body carry a large amount of fuel for braking at the planet. Pathfinder requires fuel only to navigate to Mars, and then aerobrakes into the Mars atmosphere, deploys a parachute at 10 km above the surface and, within 100 m off the surface, fires solid rockets for final braking prior to deployment of air bags that cushion touchdown. After landing, petals open to upright the lander.

The major objective of Pathfinder¬acquisition and return of engineering data on entry, descent and landing (EDL) performance¬will be completed within the first few hours after landing. In addition, the lander will transmit panoramic images of the Martian surface the first day. Next, a rover will be deployed, as early as the first day, to perform mobility tests, image its surroundings (including the lander) and place an alpha proton X-ray spectrometer (APXS) against rocks to make elemental composition measurements.

The primary mission durations for the rover and lander are one week and one month, respectively. However, there is nothing to preclude their operations past the primary mission durations, and both are expected to operate longer.

While Pathfinder is an engineering demonstration, it accomplishes a focused, exciting set of science investigations with a stereo, multi-color lander imager; atmospheric instrumentation, used as a weather station after landing; the APXS; and the rover, including its aft and forward cameras.

Pathfinder is in a special "cheaper, better, faster" project operating mode, accomplishing a challenging mission at low cost and fixed price, using a "Kelly Johnson"-like skunkworks approach, focusing on a limited set of objectives, and streamlining project approaches and minimizing bureaucratic interference. NASA's Office of Space Science office is developing Pathfinder. The Advanced Concepts and Technology Office teamed with the Space Science office developing the Pathfinder rover. Pathfinder is being performed at the Jet Propulsion Laboratory (JPL) in its in-house, subsystem mode.

The most important feature of Pathfinder's approach is collocation of all key team members on the same floor of one building around the JPL Test Bed. Collocation simplifies lines of communication and facilitates rapid iteration of requirements and resolution of issues and problems. Team members from the JPL technical divisions remain administratively tied to their home division, in what is called the "soft projectized mode," but are responsible to the project rather than to the divisions for performance, cost and schedule of their work packages. We are self-contained, including product assurance and procurement teams collocated with the project.